Claims

What is claimed is:

1.   A composition for use in the delivery of bioactive agents to a patient, said composition comprising cochleate vesicles under 2 μm in size, said cochleate vesicles comprising a charged lipid, a counter ion, a lipid covalently bonded to a polymer, and a bioactive agent.

2.   The composition of claim 1, wherein the charged lipid is a cationic lipid and the counter ion is an anionic counter ion.

3.   The composition of claim 2, wherein the cationic lipid is a fluorinated cationic lipid.

4.   The composition of claim 2, wherein the cationic lipid is selected from the group consisting of phosphatidylethanolamine, phosphatidylcholine, glycero-3-ethyl-phosphatidylcholine, a fatty acyl ester of glycero-3-ethylphosphatidylcholine, dimethyl ammonium propane, trimethyl ammonium propane, diethyl ammonium propane, triethyl ammonium propane, a fatty acyl ester of dimethyl ammonium propane, a fatty acyl ester of trimethyl ammonium propane, a fatty acyl ester of diethyl ammonium propane, a fatty acyl ester of triethyl ammonium propane, N,N'-Bis (dodecyamino-carbonylmethylene)-N,N'-bis (β-N,N,N-trimethylammoniumethylaminocarbonyl-methylene)-ethylenediamine tetraiodide, N,N''-Bis (hexadecylaminocarbonyl-methylene)-N,N',N''-tris (β-N,N,N-trimethylammoniumethylaminocarbonyl-methylenediethylenetriamine hexaiodide, N,N'-Bis (dodecylaminocarbonylmethylene)-N,N''-bis(β-N,N,N-trimethylammoniumethylaminocarbonylmethylene)cyclohexylene-1,4-diamine tetraiodide, 1,1,7,7-tetra-(β-N,N,N,N-tetramethylammoniumethyl-aminocarbonylmethylene)-3-hexadecylamino-carbonylmethylene-1,3,7-triaazaheptane heptaiodide, and N,N,N'N'-tetra (β-N,N,N-trimethylammoniumethylamino-carbonylmethylene)-N'-(1,2-dioleoylglycero-3-phosphoethanolaminocarbonyl-

methylene)diethylenetriamine tetraiodide.

5.   The composition of claim 2, wherein the anionic counter ion is selected from the group consisting of ethylene diamine tetraacetic acid, diethylene triamine pentaacetic acid, 1, 4, 7, 10-tetraazocyclododecane-N', N', N'', N''-tetraacetic acid, a dicarboxylic acid, a teraphthalic acid, a sulfide ion, a sulfite ion, a sulfate ion, an oxide ion, a nitride ion, a carbonate ion, a phosphate ion, a polymer of acrylic acid, a copolymer of acrylic acid, a polymer of methacrylic acid, a copolymer of methacrylic acid, and a polymer with at least one pendant SO_3H group.

6.   The composition of claim 1, wherein the charged lipid is an anionic lipid and the counter ion is a cationic counter ion.

7.   The composition of claim 6, wherein the anionic lipid is a fluorinated anionic lipid.

8.   The composition of claim 6, wherein the anionic lipid is selected from the group consisting of a phosphatidic acid, a phosphatidyl glycerol, a phosphatidyl glycerol fatty acid ester, a phosphatidyl ethanolamine anandamide, a phosphatidyl ethanolamine methanandamide, a phosphatidyl serine, a phosphatidyl inositol, a phosphatidyl inositol fatty acid ester, a cardiolipin, a phosphatidyl ethylene glycol, an acidic lysolipid, a sulfolipid, a sulfatide, a saturated free fatty acid, an unsaturated free fatty acid, a palmitic acid, a stearic acid, an arachidonic acid, an oleic acid, a linolenic acid, a linoleic acid, and a myristic acid.

9.   The composition of claim 6, wherein the cationic counter ion is selected from the group consisting of Be^{2+}, Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Al^{3+}, Ga^{3+}, Ge^{3+}, Sn^{4+}, Pb^{2+}, Pb^{4+}, Ti^{3+}, Ti^{4+}, V^{2+}, V^{3+}, Cr^{2+}, Cr^{3+}, Mn^{2+}, Mn^{3+}, Fe^{2+}, Fe^{3+}, Co^{2+}, Co^{3+}, Ni^{2+}, Ni^{3+}, Cu^{2+}, Zn^{2+}, Zr^{4+}, Nb^{3+}, Mo^{2+}, Mo^{3+}, Cd^{2+}, In^{3+}, W^{2+}, W^{4+}, Os^{2+}, Os^{3+}, Os^{4+}, Ir^{2+}, Ir^{3+}, Ir^{4+}, Hg^{2+}, Bi^{3+}, La^{3+}, and Gd^{3+}.

10. The composition of claim 9, wherein the cationic counter ion is selected from the group consisting of Ca^{2+}, Mg^{2+}, Zn^{2+}, Mn^{2+} and Gd^{3+}.

11. The composition of claim 10, wherein the cationic counter ion is Ca^{2+}.

12. The composition of claim 1, wherein the lipid covalently bonded to the polymer is a fluorinated lipid covalently bonded to the polymer.

13. The composition of claim 1, wherein, in the lipid covalently bonded to the polymer, the polymer is selected from the group consisting of polyethylene glycol, polyvinyl pyrrolidone, polyvinyl alcohol, polypropylene glycol, a polyvinylalkylether, a polyacrylamide, a polyalkyloxazoline, a polyhydroxyalkyloxazoline, a polyphosphazene, a polyoxazolidine, a polyaspartamide, a polymer of sialic acid, a polyhydroxyalkyl(meth)acrylate and a poly(hydroxyalkylcarboyxlic acid).

14. The composition of claim 13, wherein, in the lipid covalently bonded to the polymer, the polymer is polyethylene glycol.

15. The composition of claim 14, wherein the polyethylene glycol has a molecular weight of from about 1,000 to about 10,000.

16. The composition of claim 1, wherein the lipid covalently bonded to the polymer is selected from the group consisting of dipalmitoylphosphatidylethanolamine-polyethylene glycol, dioleoylphosphatidylethanolamine-polyethylene glycol and distearylphosphatidylethanolamine-polyethylene glycol.

17. The composition of claim 6, wherein the anionic lipid is dipalmitoyl-phosphatidic acid, the cationic counter ion is Ca^{2+} and the lipid covalently bonded to the polymer is dipalmitoylphosphatidylethanolamine-polyethylene glycol.

18. The composition of claim 1, wherein the composition further

comprises at least one lipid having a neutral charge.

19.   The composition of claim 18, wherein the lipid having a neutral charge is a fluorinated lipid having a neutral charge.

20.   The composition of claim 18, wherein the lipid having a neutral charge is selected from the group consisting of a phosphocholine, a sphingolipid, a glycolipid, a glycosphingolipid, a phospholipid and a polymerized lipid.

21.   The composition of claim 1, further comprising a targeting ligand.

22.   The composition of claim 21, wherein the targeting ligand is selected from the group consisting of peptides, proteins and saccharides.

23.   The composition of claim 1, wherein the bioactive agent is selected from the group consisting of a diagnostic agent, genetic material, a peptide, a beta-agonist, an anti-asthmatic, a steroid, a cholinergic agent, a 5-lipoxygenase inhibitor, a leukotriene inhibitor, an antineoplastic agent, an antibiotic, an anti-tumor drug, and a mitotic inhibitor.

24.   The composition of claim 52, wherein the bioactive agent is genetic material selected from the group consisting of a nucleic acid, RNA, DNA, recombinant RNA, recombinant DNA, antisense RNA, antisense DNA, hammerhead RNA, a ribozyme, a hammerhead ribozyme, an antigene nucleic acid, a ribooligonucleotide, a deoxyribooligonucleotide, an antisense ribooligonucleotide, and an antisense deoxyribooligonucleotide.

25.   The composition of claim 1, wherein the composition further comprises a gas, a gaseous precursor or a gas and a gaseous precursor.

26.   The composition of claim 25, wherein the gas and gaseous precursor

are a fluorinated compound.

27.   The composition of claim 26, wherein the fluorinated compound is selected from the group consisting of a perflurocarbon, sulfur hexafluoride and a perfluoroether.

28.   The composition of claim 27, wherein the fluorinated compound is a perfluorocarbon selected from the group consisting of perfluoromethane, perfluoroethane, perfluoropropane, perfluorocyclopropane, perfluorobutane, perfluorocyclobutane, perfluoropentane and perfluorocyclopentane.

29.   The composition of claim 27, wherein the fluorinated compound is a perfluoroether selected from the group consisting of perfluorotetrahydropyran, perfluoromethyltetrahydrofuran, perfluorobutylmethyl ether, perfluoropropylethyl ether, perfluorocyclobutylmethyl ether, perfluorocyclopropylethyl ether, perfluoropropylmethyl ether, perfluorodiethyl ether, perfluorocyclopropylmethyl ether, perfluoromethylethyl ether and perfluorodimethyl ether.

30.   The composition of claim 1, wherein the composition further comprises a fluorinated liquid.

31.   The composition of claim 30, wherein the fluorinated liquid is selected from the group consisting of perfluorohexane, perfluoroheptane, perfluorooctane, perfluorononane, perfluorodecane, perfluorododecane, perfluorocyclohexane, perfluorodecalin, perfluorododecalin, perfluorooctyliodide, perfluorooctylbromide, perfluorotripropylamine, perfluorotributylamine, perfluorobutylethyl ether, bis(perfluoroisopropyl) ether and bis(perfluoropropyl) ether.

32.   A composition according to Claim 1 wherein said lipid covalently bonded to a polymer is present in an amount from about 5 mole% to about 25 mole%, based on the total amount of lipid in the composition.

33.   A composition according to Claim 1, wherein said vesicles are under 0.5 μm in size.

34.   A composition according to claim 33, wherein said vesicles are under 200 nm in size.